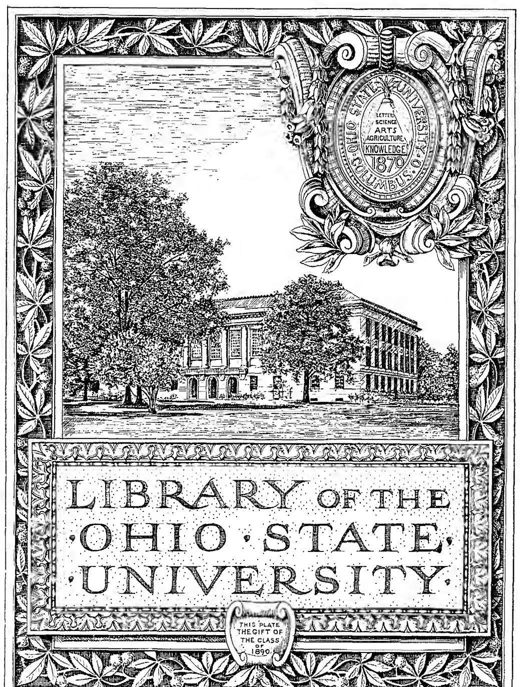
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THE

VOCAL ORGAN — ITS MECHANISM

(*Explaining a new discovery*)

By

Eugene Feuchtinger, M. A.

Illustrated in Colors

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PREFACE

OWING to the unusual character of the subject I am dealing with in this book, I fear that some of my readers may misunderstand its purpose. Therefore, I have written the following explanation.

I have made a discovery regarding the human voice that is of universal importance. This discovery lifts vocal study from a state of guess work and chance into an exact science. This book was written for the purpose of explaining and proving the discovery. To do this, it has been necessary to state technical facts, to separate and show the specific action and purpose of the different muscles, cartilages and bones that make up the vocal organism. In doing this, I have, as far as possible, avoided technical expressions that the student might the easier understand at a reading, what the expert and physiologist spent a life-time in acquiring.

To state that such and such things are so, while true, is not sufficient, for it does not prove the case. In this book I have proven my claims beyond contradiction. I have shown the true cause of strong and weak, of perfect and imperfect voices. I have definitely located the flaw that limits the power and beauty of the human voice. I have subjected my discovery to every law of physics, anatomy and mechanics, and have proven it mathematically correct. Furthermore, I have proven it to be infallible in practice in hundreds of tests.

Before a defect can be remedied, we must first find it. In the case of the human voice, both the defect and the remedy have been found, and now every voice may be

developed to the utmost it is capable of. This book reveals the defect in a way that all who read with care will recognize. While every student should read this book and become acquainted with his own vocal organism and its defects, I do not claim that from merely reading it, the voice can be corrected, though the book does point out the way.

Knowledge is power. When the student knows what is needed and what to do, he has only to persevere in the doing to accomplish his greatest desires.

No discovery in the last three hundred years has been of so much importance to the vocal student as the one herein explained.

THE AUTHOR.

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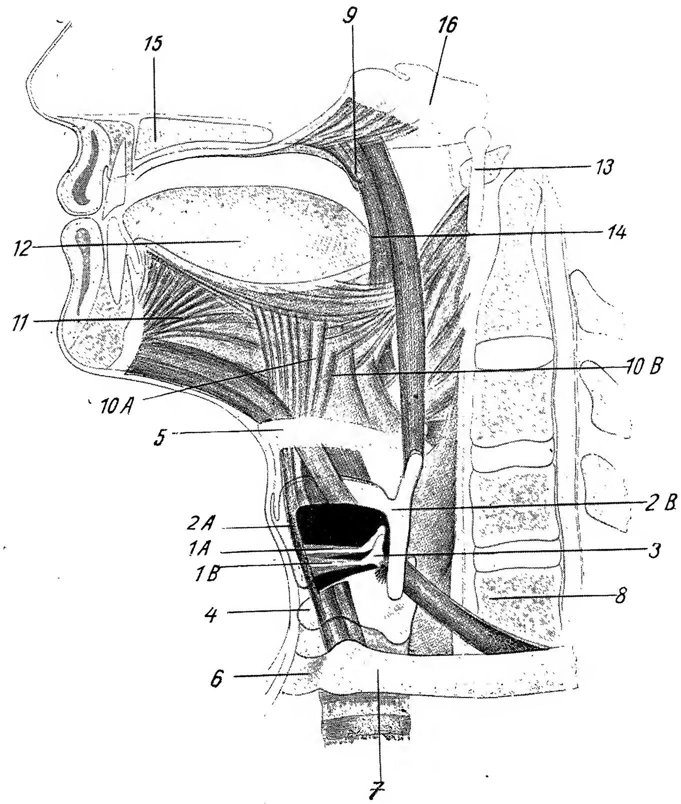

THE NORMAL VOCAL MECHANISM

Fig. 1-A-B. Vocal Chords.
Fig. 2-A-B. Thyroid Cartilage.
Fig. 3. Arytaenoid Cartilage.
Fig. 4. Cricoid Cartilage.
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PART ONE

CHAPTER I

The Perfect Voice

THE purpose of this book is to demonstrate and prove that a perfect voice, that is, a voice which will meet all artistic demands of volume, beauty and compass, can be attained, only when the instrument which produces it—the vocal organ—is perfect in all its parts. A vocal organ that is imperfect, cannot be made perfect through the mere action of singing, because in singing, the various parts of the instrument can only do what they are then capable of doing. As a rule, an imperfect vocal organ is defective only in one part, but because of this one deficient member, the action of the whole is affected and all the parts are thereby weakened.

The mere singing of scales or arpeggios cannot develop the voice to any great degree, in fact, it usually has the opposite effect for this reason: the singer does not know in what particular part of his vocal organ the weakness lies. He may sing very well up to a certain note, usually the F on the fifth line, after that the tones become hard, sharp or shrill, or faint, breathy and thin. In the first instance he supposes that he is making too much effort, which is true. He is told to relax, to loosen, to make no effort whatever. If he succeeds in doing this the result is a thin tone of no volume and one devoid of character. And if he continues using a tone of this kind, even the tones which were originally full and strong will soon become thin and weak.

All effort used in singing, except mental effort, is destructive, for it interferes with and retards the free action of the vocal organ. If the singer has to make any perceptible effort of breath or throat action to reach a certain note or a certain effect, he may be sure that his vocal organ is more or less weak, for when the vocal organ is proportionately strong in all its parts, then all tones and shades come with the utmost ease, requiring only the mental effort to produce them.

The part of the vocal organ which decides the volume, beauty, compass and most of the shading and articulation, is the tongue. The tongue sets into action the entire vocal mechanism. It is the only part that can contract with perfect ease and rapidity. Its muscles are attached at one end to a firm, inflexible bone, the chin, and at the other end to the freely moving larynx and to other muscles. It lies between the hard and soft palate above and the larynx below, and works like a lever, trying to draw the palate and larynx toward each other. Now in just the degree that the tongue possesses strength, can it awaken force in the other parts of the vocal organ, because no muscle can exert a greater power than is supplied by the resistance against which it acts and reacts. To illustrate: lift a book from the table and notice how little force is exerted, how little your muscles contract. Then lift a chair and note how much more power your muscles exert. Next, let a friend sit on the chair and then try to lift it. Here you find a resistance that calls forth the utmost your muscles are capable of. From this simple experiment you can learn a valuable lesson in the law of resistance. In lifting the book you met with very little resistance, hence you exerted very little muscular power; lifting the chair called forth much more

power, but it was only the third experiment that really proved the power you possessed, that showed you what you were capable or incapable of doing.

The lesson is this: The vocal chords can contract so that they become thin and attenuated, in which case the tone is also thin and the compass small, or they can become thick and tense, in which case the tones will be strong and the compass large. How this is done and what mechanism Nature has provided for doing it, will be given in the succeeding chapters. I will state here, however, that to give forth sound, the vocal chords must be stretched similarly to the strings of other instruments. Nature has made two provisions for stretching the vocal chords, one is internal within the larynx and entirely automatic, the other is external, being the muscles which connect the larynx to the collar bone, the tongue and the head. The external stretching is voluntary and is produced almost entirely through the activity of the tongue. When the vocal chords are thin, the resistance to be overcome is very little, and the power within the larynx is usually sufficient to stretch them. But the tones, in such a case, will be thin. They may be sweet and pretty and sufficient in strength to meet the requirements of amateur singers, but since they lack volume they are without pathos and character, and are utterly unsuited to public performance or even to the more pretentious private singing. But when the vocal chords enlarge in size and contract strongly, the resistance which has to be overcome to stretch them is very great, so that an unusual power of the external, voluntary muscles is required to do the stretching. This external chord-stretching power is possessed principally by the great international singers. But, as one

may acquire a great piano technic, so one may develop the mechanism which will produce as good a voice as that possessed by any of the greater singers. Technic, whether in playing an instrument, or in using the human voice, is, in the main, strength and muscular development under control. All that is needed is to know how to develop the right muscles and then use them persistently.

The preëminence of the tongue as the chief factor in the voluntary external stretching of the vocal chords, has been recognized by many physiologists in England, France and America. And recent exhaustive experiments by one of the most prominent German throat specialists have proven that the tongue can be so developed and with comparative ease, that all the requirements of a perfect voice can, in this simple way, be acquired.

Professor Dr. Kraus, of the Royal Charity Hospital of Berlin, in his book on throat and laryngeal diseases, says: "These laryngeal diseases can be noticed by people who have much work to do with their vocal organs, as, for instance, singers, speakers, commanding officers, etc. Where a certain inactivity of the tongue muscles exist, there will be noticed a weakness which often causes stammering and even a complete loss of voice. Many years' experience has taught me that such faults can be comparatively easily cured through the right kind of tongue exercises. In this way the muscle which alone can stretch the vocal chords will be developed and strengthened. It is entirely erroneous to suppose that, for instance, singers who have large larynxes also possess large voices. I have had cases in my practice where singers of acknowledged large and fine voices

had by Nature only a small larynx, but, unknown to themselves, their tongue muscles were unusually strongly developed, and because of this unusual strength they could stretch their vocal chords with great power and ease."

Dr. Bennati, a French specialist of the early part of the last century, physician to the Royal Opera of Paris, who as such treated the most famous singers of his day, such a Catalani, Tosi, Rubini, Santini and LaBlache, says: "When the muscles of the tongue and the hyoid bone are severed or paralyzed, then the muscles of the larnyx can produce only a weak and dull tone. There is certainly, during singing, a very great contraction of the tongue muscles, as one can easily prove by laying a finger against them. Furthermore, there is noted a greater size of the tongue in singers whose voices are especially fine and rich."

These authorities are only two among many who agree that the principal agent in all voice production is the tongue. However, it is better to learn all there is to be learned of a subject and so convince yourself, without leaning on the judgment of others or even on such authorities as here quoted. To enable the intelligent student to form his own conclusions, is the main object of this book. In order to give a logical sequence of cause and effect, we must understand first the nature of a tone, secondly, the instrument which produces that tone, and, lastly, the mechanism of this instrument. The principal divisions of this book will, therefore, be devoted to:

First. The Laws of Physics and Sound.
Second. The Laws of Physiology and Anatomy.
Third. The Law of Mechanics.

The object of the singer is to excite pleasing emotions. He reaches this object, not so much by means of technic or the form of his subject, as by the beauty of sound. Therefore, the singer's first object must be to attain the highest ideal of beauty in his tone.

CHAPTER II

The Laws of Physics and Sound—Character of Sonorous Motion

EXTRACTS from Tyndall's excellent work will explain the nature of Sound.

The various nerves of the body have their origin in the brain, which is the seat of sensation. When a finger is wounded, the nerves convey to the brain intelligence of the injury, but if these nerves were severed no pain would be experienced, no matter how serious the injury might be. Applying a flame to a small collodion balloon which contains a mixture of oxygen and hydrogen, the gases explode and the ear is conscious of a shock, which we name sound. How was this shock transmitted from the balloon to our organs of hearing? The process was this: When the flame touched the mixed gases in the balloon they combined chemically and their union caused the development of intense heat. This heated air expanded suddenly, violently forcing the surrounding air away on all sides. This motion of the air close to the balloon was rapidly imparted to that a little further off. The air at a little distance passed its motion to the air at a greater distance, thus each particle of air took up the motion of the one preceding and transmitted it to the succeeding particle of air, thus propagating a pulse or air wave.

The propagation of sound may be explained by a homely but useful illustration. In illustration One are placed five boys in a row, one behind the other, each boy's hands resting against the back of the boy in front of him. E is foremost and A finishes the row. Sup-

pose somebody suddenly pushes A, then A pushes B and regains his upright position. B pushes C and so on. E, having no one in front of him, is thrown forward. Had E been standing on the edge of a precipice, he would have fallen over. Had he stood in front of a window he would have broken the glass. Had he been close to a drumhead he would have struck the drum. Thus, sound is sent through the air and strikes the drum of the distant ear.

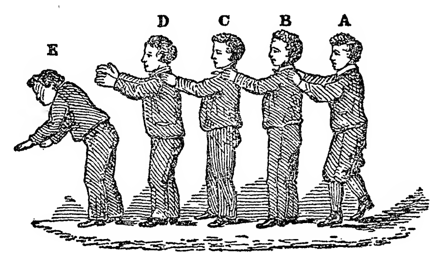

Illustration One

Intensity of Sound

In the case of the exploding balloon the wave of sound expands on all sides, the motion produced by the explosion being thus diffused over a continually augmenting mass of air. Suppose our balloon to be a thin shell with a radius of one foot, reckoned from the center of explosion. A balloon of the same thickness, but of two feet radius, will contain four times the quantity of matter; if its radius be three feet, it will contain nine times the quantity of matter; if four feet, it will contain sixteen times the quantity of matter, and so on. Thus the intensity or loudness of sound increases as the quantity of matter set in motion augments.

Velocity of Sound Waves

By sending a sound through a tube with a smooth interior surface, it may be transmitted to a great distance with very little diminuition of intensity. Illustration Two represents a tin tube, fifteen feet long. At the pointed end of the tube is placed a lighted candle, (C). When the hands are clapped at one end of the tube, the flame instantly ducks down at the other. It is not quite extinguished, but it is forcibly depressed. At the instant two blocks of wood (B. B.), are clapped together, the candle is blown out. This shows in a rough way the speed with which sound waves are propagated. The

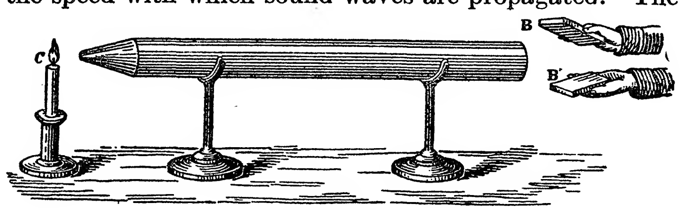

Illustration Two

instant the clap is heard the flame is extinguished, though the sound had to travel fifteen feet. The time required for the sound to travel through this tube is too short for our senses to appreciate. (This also disposes of the mistaken notion that a tone can be directed at the will of the singer to the chest, the face or to the head, for the very simple reason that the tone has left the singer's throat and is beyond his control before he hears it.)

Velocity and Intensity

In regard to sound and the medium through which it passes, four distinct things are to be borne in mind, velocity, elasticity, density and intensity.

The velocity of sound depends upon the elasticity in relation to its density. The greater the elasticity, the swifter is the propagation. The greater the density, the slower is the propagation. Thus a steel rod will propagate sound four times faster than the same rod made of lead, because lead is four times as dense as steel.

The velocity is directly proportional to the square root of the elasticity. Thus, suppose a rod of steel, half an inch thick and one foot long to equal the middle C on the piano; then a rod of the same thickness but only one-half foot in length will equal the octave above.

The intensity of sound is proportional to the square root of the sounding material.

CHAPTER III

Musical Sounds

IF THE eyes were sharp enough to see the vibrations and alterations of the air through which a voice was passing, we might find there some wonderful knowledge. In ordinary conversation, the physical both precedes and arouses the psychical (emotion); the spoken language which gives us pleasure or pain, rouses us to anger or soothes us to peace, exists for a time between us and the speaker as a purely mechanical condition.

Noise affects us as an irregular succession of shocks. We are conscious of a jolting and jarring of the auditory nerves, while a musical sound flows smoothly and regularly. How is this smoothness secured? By rendering the impulses received by the tympanic membrane perfectly periodic. The motions of a common pendulum, for example, are periodic, but they are far too sluggish to excite sonorous waves. To produce a musical tone we must have a body which vibrates with the unerring regularity of the pendulum, but which can impart much sharper and quicker shocks to the air. The only condition necessary to the production of a musical sound is that pulses should succeed each other in the same interval of time. If a watch, for example, could be caused to tick with sufficient rapidity, the ticks would blend to a musical tone, and if the strokes of a pigeon's wings could be accomplished at a much accelerated pace, the progress of the bird through the air would be accompanied by music. In the humming bird the necessary rapidity is attained. If the puffs of a locomotive could

be increased to fifty or sixty a second, the approach of the engine would be heralded by an organ peal of tremendous power.

The production of a musical sound can be illustrated by causing the teeth of a rotating wheel to strike in quick succession against a card.

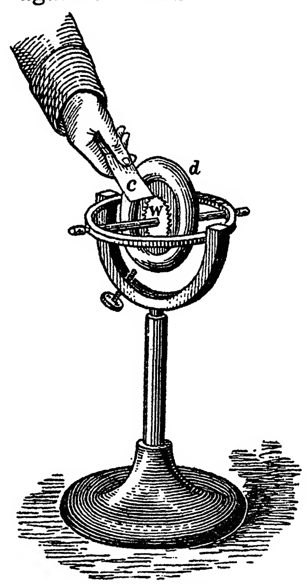

Illustration Three

The above gyroscope consists mainly of a heavy brass ring D; along with it rotates a small toothed wheel W. On touching this wheel with the edge of a card, C, and rotating the brass wheel, a musical sound is produced. By increasing the rotating motion, the tone becomes higher; by lowering the motion, the tone becomes deeper. This proves the important fact that the pitch of a note depends upon the rapidity of its pulses.

Definition of Pitch

When two notes from two distinct sources are of the same pitch, their rates of vibrations are the same. If a tuning fork yields the same note as an organ pipe or the tongue of a concertina, it is because the vibrations of the fork in the one case are executed in precisely the same time as the vibrations of the column of air in the organ pipe, or of the tongue in the concertina. The same holds good for the human voice. If a violin string and a voice yield the same note, it is because the vocal chords of the singer vibrate in the same time as the string vibrates.

The pitch of a musical note depends solely upon the number of vibrations concerned in its production. The more rapid the vibrations, the higher the pitch.

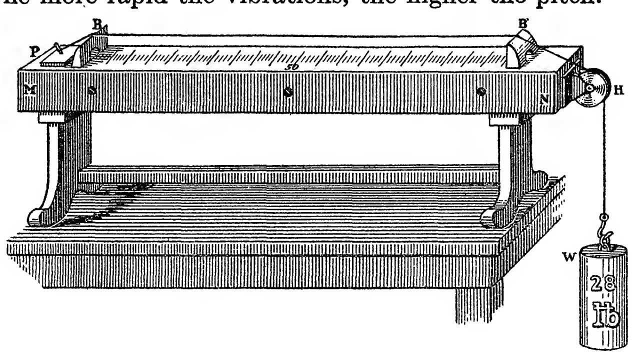

Illustration Four—Monochord

Vibrations of Strings

To enable a musical string to vibrate it must be stretched between two rigid points. Illustration Four is an instrument employed to stretch strings and to render their vibrations audible.

From the pin P, to which one end of the string is firmly attached, it passes across two bridges (B and B), being afterward carried over the wheel H. The string is firmly stretched by a weight (W), of twenty-eight pounds, attached to its extremity. The bridges (B and B), which constitute the real ends of the strings, are fastened on to the long wooden box (M N). The whole instrument is called a monochord or sonometer. Plucking the stretched string at its middle, you hear a sound, but the sonorous waves which strike the ear do not proceed directly from the string. The amount of wave motion generated by so thin a body as the string, is too small to be noticeable at any distance. But the string is tightly drawn over the two bridges and when it is made to vibrate, its tremors are communicated through these bridges to the entire box. And the box after intensifying the vibrations, transmits them to the surrounding air, thereby setting it into motion.

Laws of Vibrating Strings

Having learned how the vibrations of strings are rendered available in music, we must next investigate the laws of such vibrations. Plucking the string of Illustration Four, the sound heard is the lowest or fundamental note of the string, to produce which it swings as a whole to and fro. By placing a movable bridge under the exact middle of the string and pressing the string against the bridge, the string is divided into two equal parts. Plucking either of those two divisions, a note is obtained which is exactly an octave above the fundamental note. In all cases and with all instruments of whatever kind, the octave of a note is produced by

doubling the number of vibrations. One-half of this string vibrates with twice the rapidity of the whole string. In the same way one-third of the string vibrates with three times the rapidity, producing a note one-fifth above the octave; while one-fourth of the string vibrates with four times the rapidity, producing the double octave of the whole string. In general terms, the number of vibrations is inversely proportional to the length of the string; the smaller the divisions of the string, the higher the tone. Again, the more tightly a string is stretched, the more rapid are its vibrations. By plucking the string with one hand, while the other hand alternately lifts and presses upon the weight, the quick variations of tension will produce a varying, wailing tone. By applying different weights to the end of the string and determining in each note the number of vibrations executed in a second, we find the numbers thus obtained to be proportional to the square root of the stretching string. A string, for example, stretched by a weight of one pound, executes a certain number of vibrations a second. If we wish to double the number of vibrations, we must stretch the string by a weight of four pounds; if we wish to treble the vibrations we must apply the weight of nine pounds, and so on. The vibrations of a string also depend upon its thickness. If, therefore, of two strings of the same material, equally long and equally stretched, the one has twice the diameter of the other, the thinner string will execute double the number of vibrations of the other in the same time. If one string be three times as thick as the other, it will execute one third the number of vibrations, and so on.

Finally, the vibrations of a string depend upon the density of the matter of which it is composed. If the

density of one string, be one-fourth of that of another of the same length, thickness and tension, it will execute its vibrations twice as rapidly; if the density be one-ninth that of the other, it will vibrate with three times the rapidity, and so on. Therefore, the number of vibrations is inversely proportional to the square root of the string.

In the violin and other stringed instruments, we avail ourselves of thickness instead of length to obtain deep tones. The human voice is a mechanical instrument only in so far as the different parts composing it must be in exact uniformity to produce equal results with the mechanical instruments. Also it is subject to the same laws in regard to velocity (number of vibrations), elasticity, density and intensity. That is, the same number of vibrations per second produce the same pitch either in a mechanical instrument or in the human voice. The elasticity of the vocal organ is another necessary adjunct, for if this organ were in a tight, stiff state, it could not vibrate freely.

In the same way there must be a certain density of the vocal chords, otherwise the tone would be devoid of intensity; it would be too faint and thin to produce tones of character and substance. But the vocal instrument is in all other respects unlike the mechanical instrument, because the vocal instrument is subjected to our will and directed by our intelligence, enabling it to be trained to the highest perfection. For instance, many musical instruments require provision for each separate tone and the means of changing the character, intensity, tone color, etc., are small, but in the vocal organ such changes are so manifold that the same note can be produced with constant variations, creating ever new results.

CHAPTER IV

Overtones—Tone Quality

IT HAS been shown that a stretched string can either vibrate as a whole or divide into a number of equal parts, each of which vibrates as an independent string. Now, it is not possible to vibrate one section of the string without at the same time affecting, to a greater or less extent, its subdivision; that is to say, added upon the vibrations of the one section; we have always, in a greater or less degree, the vibrations of its aliquot parts. In the experiment with the monochord, when the wire was to be shortened, a movable bridge was employed, against which the wire was pressed so as to deprive the point resting on the bridge of all possibility of motion. This strong pressure, however, is not necessary. If we press the feather end of a goose quill lightly against the middle of the string, and draw a violin bow over one of its halves, the string yields the octave above the note yielded by the whole string. The mere damping of the string at the center by the light touch of the feather is sufficient to cause the string to divide into two vibrating segments. Nor is it necessary to hold the feather there throughout the experiment; after having drawn the bow, the feather may be removed, the string will continue to vibrate, emitting the same note as before. To prove that when the center is damped and the bow drawn across one of the halves of the string, the other half also vibrates, place across the middle of the untouched half a rider of paper. Damping the center and drawing the bow, the string shivers and the rider is overthrown.

When the string is damped at a point which cuts off one-third of its length, and the bow drawn across the shorter section, not only is the shorter section thereby thrown into vibration, but the longer section divides itself into two ventral segments with a node between them. Damping the string at the end of one-fourth of its length

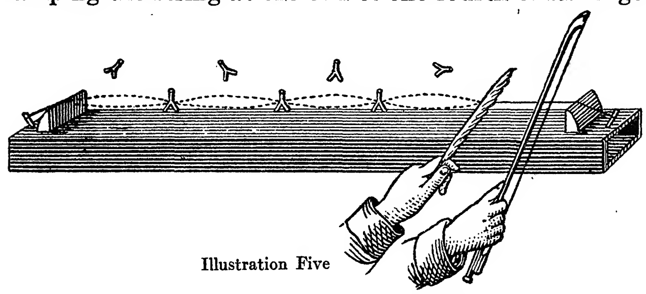

Illustration Five

if the bow is drawn across the shorter section, the remaining three-fourths divide themselves into three ventral segments with two nodes between them. Damping the string at the end of one-fifth of its length, the remaining four-fifths divide into four ventral segments, with three nodes, and so on. The higher notes produced by these subdivisions are called the harmonics of the string. And so it is with other sounding bodies. We have in all cases a coëxistence of vibrations, that is, the higher tones mingle with the fundamental one, and it is their intermixture which determines what we term the quality of the sound. It is this union of high and low tones which enables us to distinguish one musical instrument from another. A clarionet and violin, for example, though tuned to the same fundamental note, are not confounded; the auxiliary tones of the one are different from those of the other, and these latter tones, uniting themselves to the fundamental tones of each of the two instruments,

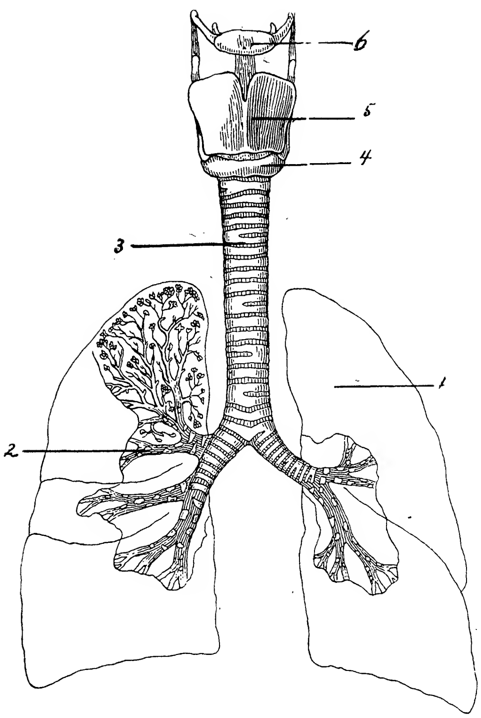

ILLUSTRATION VI

THE AIR TUBE OR TRACHEA

1. Lungs.	4. Cricoid Cartilage		Vocal Tube
2. Bronchial Tubes.	5. Thyroid Cartilage		
3. Trachea (Air Tube).	6. Hyoid Bone		

differentiate the identity of the sounds. All bodies and instruments employed for producing musical sounds emit, besides their fundamental tones, others due to higher orders of vibration. Such sounds are known under the general term of overtone, or aliquot tones.

Color depends upon rapidity of vibration, blue light bearing to red the same relation that a high tone does to a low one. A tone, then, may be defined as the product of a vibration, which cannot be decomposed into more simple ones. An assemblage of tones such as we obtain when the fundamental tone and the overtones sound together, constitute the tone quality.

To the voice student the question of tone quality is the all-important one; upon it depends his success or failure as a singer, for no matter how much technic he may acquire, or however pleasing his personality may be, if his voice is deficient in quality, his success will be meager. Even in a purely technical sense, he will fail to meet the demands of higher artistic interpretation because his voice will fail him at the moment of climax. He has given all he has long before the apotheosis of ecstasy in the song is reached. The spirit may be willing, but the flesh—the vocal organ—is weak.

On the other hand, if the vocal organ is fully developed, then the quality of the singer's tone will arouse enthusiasm, even with the simplest song. As I write this I have in mind one of my students whose voice is a marvel of beauty; his compass now reaches from A below the staff to F above high C, each tone as full and distinct as if chiseled. He was offered a very large sum of money and a pension to his family, merely to lead the chorus; himself to stand unseen behind the scenes, for unfortunately he is—a hunchback.

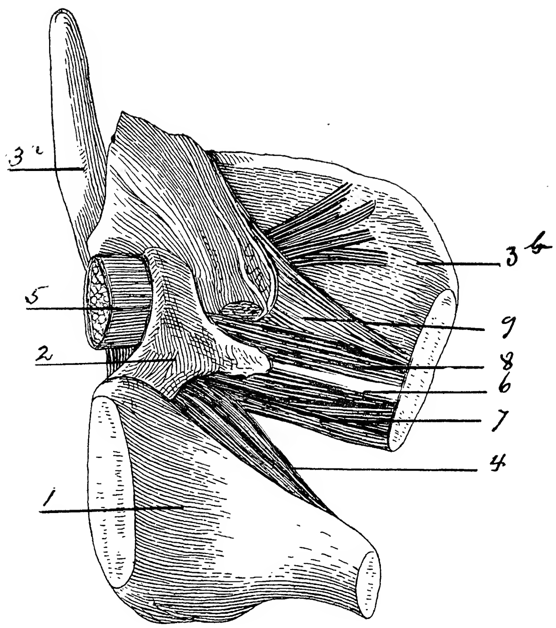

ILLUSTRATION VII

CRICOID, THYROID, ARYTAENOIDES CARTILAGES AND VOCAL CHORDS

1. Cricoid Cartilage.

2. Arytaenoides Cartilages.

3-a. Thyroid Cartilage (Horn).

3-b. Thyroid Cartilage (Adam's Apple).

4, 5. Crico-Arytaenoides Muscles.

6. Vocal Cords (their sharp edge).

7, 8, 9. Interior Wall Muscles which reënforce and enlarge the Vocal Chords.

PART TWO

CHAPTER V

The Laws of Physiology and Anatomy

WE HAVE learned that a tone is primarily the result of a certain number of vibrations a second. If these vibrations increase then the pitch of the tone rises; if the vibrations decrease, the pitch of the tone becomes lower. For instance, the middle C on the piano is composed of 256 vibrations per second. Twice that number of vibrations gives us the octave above or the C in the third space. If the vibrations are increased to 1024 per second, we obtain the high C on the piano. This, of course, holds good for the voice also. But in addition to the pitch, we must also obtain quality and this, as we have seen, is the result of overtones. The auxiliary tones which accompany the primary of fundamental tone, decide whether a tone is good or bad. Of all musical instruments, the human voice contains under the right conditions, the most overtones. This accounts for the preference of the human voice over other instruments. Among all races and in all history it is the perfect human voice that gives the greatest satisfaction, the most complete joy.

Now a little reflection will show that the fundamental tone must be strong, at least strong enough to impart some volume to the overtones, else they could not be heard and the quality would be lost. This accounts for the fact that singers with full, far-reaching tones, are

meeting with phenomenal success, while others, with sweet but small voices, linger in partial obscurity. But it is not enough to have a full, strong tone, it must be without the least suggestion of hardness or sharpness; it must flow with the utmost ease and give joy alike to singer and listener.

The main object of the voice student must be, therefore, to develop all his resources so that his tones may be strong, free and easy. This he can obtain in no other way than by perfecting his vocal organ, and since the vocal organ is composed of bones, muscles and nerves, it may be studied and analyzed, and all may understand the process and form their own conclusions without leaning on the judgment of others.

CHAPTER VI

The Vocal Organ—Vocal Chords

I WILL describe only those cartilages, bones and muscles which directly or indirectly form a part of the vocal organ. Usually the three cartilages which form the principal part of the larynx, together with the vocal chords which they enclose, is referred to as the vocal organ. This is a common, but mistaken conception. One might as well refer to four walls as a house, leaving out of consideration the foundation on which the house was built, and the roof which covers it. The larynx, it is true, is the most important part of the vocal organ. But if there were no muscles to set it in motion or bones to give these muscles a basis from which to contract, the singer's chances would be very poor, indeed. Not much beyond a coughing sound could be emitted and certainly no musical sounds could be produced. The muscles which surround the larynx bear to it the same relation as the tongue and wheels bear to the wagon. Neither is complete without the other. Furthermore, the singer can learn to control the muscles (at least the tongue muscles, and they are the principal ones concerned in the voluntary production of artistic sound), but if he should even attempt to control the larynx, good tones would be impossible. Of course the primary part from which sounds are emitted is the vocal chords. These are enclosed within the larnyx, and the larynx is the uppermost part of the trachea, or air tube, through which we breathe.

The following illustration gives a very exact picture of the lungs, the air tube and the larynx. All these parts

together are known as the respiratory apparatus. The air tube or trachea is, as its name implies, a hollow tube, consisting of from sixteen to twenty cartilages, each shaped like a ring, with the rear part flat. Between the flat part of the rings and the spine is the aesophagus, or food pipe, which leads to the stomach. The air tube branches at its lower end into two principal parts and from these are many small branches, all of them imbedded in the lungs, like the roots of a tree are imbedded in the earth. When the lungs expand a vacuum is created which is at once filled by air rushing through the mouth and nose into the air tube. The upper end of the air tube is formed of three larger cartilages which constitute the larynx or vocal tube. The basis of the larynx is the cricoid or ring cartilage, upon which rests the thyroid or shield cartilage. This cartilage is formed of two plates which unite in front. Their rear ends stand apart and horns extend into the hyoid bone above it and downward over the sides of the cricoid bone. Only the rear under part of the thyroid cartilage nearest the spine, rests upon the cricoid, leaving an open space between them in front. The bone above the thyroid cartilage is of very great importance to the singer and speaker, because all the power of the tone and the ability to stretch the vocal chords arises out of the proper action of this tongue or hyoid bone. The hyoid bone is shaped somewhat like a horseshoe; it has a thick body in front; out of this frontal body grow two long horns which extend backward and somewhat upward toward the spine. There are also two smaller horns in front. The two cartilages and the hyoid bone are connected with each other by striped voluntary muscular bands and fibers, which draw them toward each other, combining the three parts into

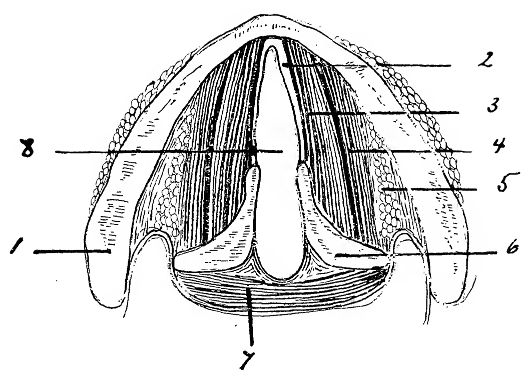

ILLUSTRATION VIII

HORIZONTAL CUT THROUGH THE VOCAL CHORDS AND SURROUNDING MUSCLES AND CARTILAGES

1. Thyroid Cartilage.

2. Vocal Chords.

3. 4. 5. Muscles which reënforce and enlarge the Vocal Chords.

6. Arytaenoides Cartilages.

7. Muscles connecting Arytaenoides with Cricoid Cartilage.

8. Glottis (open space between the Vocal Chords, when at rest).

one close tube, about as the three parts of a flute can be joined together to form one tube. Through this joining of the cartilages and hyoid bone, the fibers and muscles which line the inner sides of this tube are brought toward each other and stretched, and when these stretched-and-touching-each-other muscles are set into vibration by the breath coming from the lungs, through the air tube, tones are produced which change the upper part of the air tube into a vocal tube. A more detailed description of these important parts of the larynx is necessary to a practical understanding of the mechanism of the voice and to the appreciation of the fact that it is not possible to change or add to the bones which form the basis of the larynx, but that it is possible to develop to the utmost the muscles which connect with these bones, thereby making artistic singing not only possible, but an assured fact to all who are willing to work.

The Larynx

The following description of the larynx is translated from the recent work on anatomy by Ad. Pansch, professor at the University of Kiel.

"The larynx lies in the center of the throat. It is a short tube of movable cartilages, within which lie the vocal chords. The changing of positions and the stretching of these chords are accomplished by special larynx muscles."

The Cricoid Cartilage

The basis of the larynx is the cricoid or ring cartilage, which lies as a solid ring upon the upper end of the air tube. It has the form of a ring somewhat narrow in front; it rises towards the rear into and between the plates of the thyroid cartilage. On both sides of the ring are

two depressions, into which are fitted the arytaenoides (tooth cartilage). In the opposite illustration (VII), both the cricoid and the arytaenoides cartilage and their relation to one another may be plainly seen.

The Thyroid Cartilage

This cartilage consists of two four-cornered plates which join in the form of a large triangle. The upper part of this triangle varies in its projection in different people and is known as "Adam's Apple" (Fig. 3 b). The rear sides of the two plates continue upward and downward in the form of horns (Fig. 3 a). The upper and longest horns serve to connect directly with the hyoid bone (tongue bone) above it. The shorter, lower horns, embrace the cricoid cartilage below. From this position the thyroid cartilage moves forward or backward as on pivots and thus assists in the stretching of the vocal chords; hence it is sometimes called the stretching cartilage.

The Arytaenoides

The arytaenoides (Fig. 2) are in general three-sided, irregular pyramids which stand on both sides of the back and uppermost parts of the cricoid cartilage. As these little cartilages are enveloped in muscles, they fill out the rear or open space of the thyroid cartilage. The under inner side is hollowed out to fit upon the steep sloping sides of the cricoid cartilage (Fig. 1); from these points the cartilages are moved toward and from each other by muscles which connect them to the cricoid and thyroid cartilages (Figs. 4, 5). Out of these arytaenoides grow the vocal chords (Fig. 6), extending forward to the inner corner of the front of the thyroid cartilage, their muscles

and fibers filling at the same time the space between themselves and the inner walls of the thyroid plates (Figs. 7, 8, 9), so that whatever affects the movements of these little arytaenoides bones, at the same time affects the vocal chords. See illustrations Seven and Eight.

The Hyoid Bone

This bone has the shape of a horseshoe. It lies directly above the thyroid bone and is attached to the rear part of the tongue between the third and fourth vertebrae. It is easily found by pressing against the corner made by the lower jaw and the throat. The middle and forward-bending part of the hyoid bone is the hyoid body, rather thick and strong. Out of it extend two long horns which reach far back into the throat; also two shorter horns. From these horns and from the body itself, extend muscles which, like the ropes from a masthead, attach themselves to many different points of the head, jaw, neck and chest. See illustration Six.

The Epiglottis

This is a cartilagenous, fibrous body, growing out of the larynx, somewhat tongue-shaped and very elastic. Its purpose is to cover the vocal tube during the act of swallowing, to prevent the food from passing into the air tube. It has no vocal office whatever, though formerly it was thought to have some vocal effect. But this has been entirely disproved.

CHAPTER VII

The Vocal Chords

THE vocal chords extend from the roots of the arytaenoides along the inner side of the two plates of the thyroid cartilage to the angle where these plates are joined together and form the sharp corner in front of the throat. Since these edges of the vocal chords meet at the angle of the thyroid cartilage, they touch each other at that point, but are farther and farther apart as they stretch across to the arytaenoides on the right and left sides of the cricoid upon which these rest. The vocal chords are not thin muscles, which, as is sometimes supposed, resemble a string or a wire; far from it. They are more like muscular bands, being, in fact, rather broad, extending from about the middle of the thyroid cartilage nearly down to the cricoid cartilage. Bearing this broad band shape of the vocal chords in mind, it can easily be seen that in singing, these bands do not touch each other in their entire width; if they did, no breath could get through to set them into vibration, and, of course, no tone would be possible. The vocal chords must approach each other and form a sharp edge. This is brought about mainly through other muscles which lie behind the real vocal chords and which help in rotating the arytaenoides upon their pivots to bring the edges of the vocal chords toward each other. In thus contracting, they force the upper parts of the vocal bands toward each other, bulging them in such a way that sharp edges appear which can easily be set in motion by the breath. But in perform-

ing this office they also perform still another, in that they enlarge the vocal chords, making them much thicker. From the chapter on the laws of physics and sound, we have learned that a tone is either weak or strong in proportion to the vibrating, tone-producing material. A thin chord will give much weaker tones than a chord four or eight times thicker. Now, if only the vocal chords vibrate, the sound can be only of a certain strength, no matter how much breath pressure might be brought to bear; the breath cannot change the vibrating material in the least, but since the muscles which lie between the vocal chords and the wall of the thyroid cartilage contract very sharply and force the vocal chords toward each other, and also into a sharp edge, they add their own size, density and strength to the vocal chords, and consequently they also vibrate with them, being, in fact, like one compact pair of muscles instead of several separate pairs. We may compare this with the bass strings of a piano where the wires are re-enforced with additional wires which are tightly wound around them, thus making the original wires perhaps four to eight times heavier, and, of course, the tone so much stronger and larger. Anticipating later chapters, I may here say that, like the heavily covered piano wires, the re-enforced vocal chords vibrate much slower, consequently a high tone is only possible when a great stretching power exists which enables the singer to stretch these re-enforced vocal muscles sufficiently to meet the necessary number of vibrations needed for the higher tones. And any singer who develops this needed stretching power is thereby raised from the ranks of mediocrity to a high artistic level. Those who have not this power can develop it until it is as good, or even better, than that of the greatest singers the

world now has or ever has had. This is no hypothesis, but a mathematical certainty.

In illustration VII, the action of the vocal chords and the muscles behind them is plainly visible. The muscle in front (the thin white line), being the real vocal chord, those behind contract sharply, and, of course, become shorter and thicker, which causes the chords on either side to bulge toward each other into a sharp edge. At the same time the arytaenoides are revolved so that the chords quite or nearly touch each other. Illustration VIII still more plainly shows that the vocal chords (Fig. 2) can be re-enforced and enlarged to an almost unlimited extent by the surrounding muscles (Figs. 3, 4, 5), thereby adding more and more volume to the tone, and, of course, more audible overtones which, as was shown in the beginning chapters, adds greater and greater beauty to the tone quality.

In illustration VIII the vocal chords (Fig. 2) are plainly visible as the first layer of muscles growing out of the points of the two arytaenoids (Fig. 6), and meeting in the center of the thyroid cartilage (Fig. 1). Picture them as bands extending downward to nearly the cricoid cartilage. The empty space between them is called the glottis (Fig. 8). Behind the vocal chords are other layers of muscles (Fig. 3, 4, 5); their attachments are also from the arytaenoids to the front of the thyroid cartilage. Remembering that the arytaenoides rotate upon the top of the cricoid cartilage, it is clearly seen that such a rotating action will bring the vocal chords, and with them, of course, all the muscles behind them, toward each other. This is exactly what happens in singing and also, but to a less extent, in speech. The nerves which supply these muscles, stimulate them to contrac-

tion and hold them during the musical phrase or spoken sentence, after which, as there must be a slight pause between sentences, or phrases, the muscles relax and resume their original shape, to be brought to instant contraction on the beginning of a new sentence. It is of the utmost importance to keep in mind that the front attachment of the vocal layers of muscles grow out of the thyroid cartilage and are permanently fixed at that point. The opposite ends are movable, because they are attached to the freely moving, rotating pair of arytaenoides cartilages. As the chords contract, these arytaenoides wheel around. But if there were no other muscles, the arytaenoides would be drawn forward, away from the back of the cricoid toward the front of the thyroid. To prevent this, muscles have been provided which hold these arytaenoides in place; in fact, they pull strongly backward, just as strongly as the vocal chords pull forward, and thereby help in stretching the chords. These backward-pulling muscles (Fig. 7) arise out of the back of the cricoid and are fastened to the rear of the arytaenoides, where they are assisted by still other muscles in this backward pulling. The student is earnestly requested to examine these points closely as they are of importance to him and to his understanding of the following chapters. The day has passed when merely the thoughtless singing of exercises suffices to make an artist. Clear thinking and scientific reasoning alone are the keys which will open the door to vocal success. We are dealing with a substantial science, one that is as much a matter of fact as the playing of a piano or a violin. But the singer must be his own creator, so to speak; he cannot buy a perfect voice, he must know what to do and then do it.

In the first chapter it was said that Nature provided two means of stretching the vocal muscles; one, the internal, has just been described, the other, or external, will follow. But, in anticipation of the future chapters, it may be said that the internal stretching is entirely insufficient for the modern tone. Where in opera, concert or church, a full, rich, scintillating tone is required, a thin, small voice has no chance against a modern orchestra or even an organ. The ethical demands made by modern composers require a tone that from the slightest "piano" can be increased to a voluminous "fortissimo." The pleadings of the softest whisper of longing must, if need be, increase to the utmost cry of intense passionate love or hate. Nature has made full and overflowing provision for all this. The vocal muscles as they lie within the confines of the larynx can stretch but little. The space from the thyroid to the arytaenoides is too small. It is only when the thyroid cartilage is being tilted downward that the stretching can be increased. This action must take place before the chords can be completely stretched. The stretching is accomplished, however, by external muscles, which will presently be described. The external stretching of the vocal chords is voluntary and under the student's control, and the method can be learned by anyone who will give the subject a little intelligent consideration.

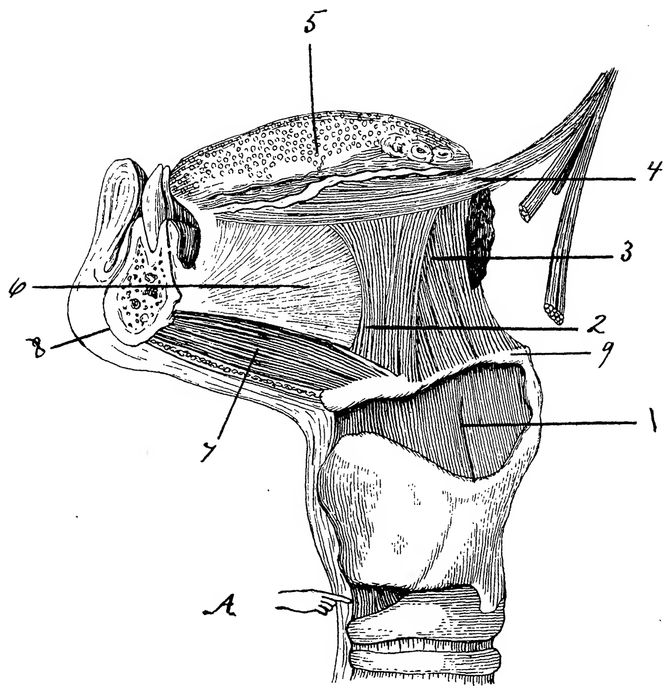

ILLUSTRATION X

A. Open space between Cricoid and Thyroid Cartilages.
1. Thyro-Hyoid Muscle.
2. Hyo-Glossus Muscle.
3. Chondro-Glossus Muscle.
4. Style-Glossus Muscle.
5. Glossus (Tongue).
6. Genio-Glossus Muscle.
7. Genio-Hyoid Muscle.
8. Genio (Jaw).
9. Hyoid Bone.

CHAPTER VIII

MUSCLES CONNECTING THE CARTILAGES OF THE LARYNX

THE two principal cartilages, the cricoid and the thyroid, are connected with one another, as is seen in Illustration IX, first by the ligament (Fig. 1), crico-thyroideus, which connects the front sides of the two cartilages. A muscle can be either elongated or shortened. The shortening, or contraction, of a muscle serves to bring the two parts to which it is attached toward each other, while an elongation would separate them. The elongation is brought about by a forcible outward pull, which stretches it beyond its natural length, thereby weakening it. Only a natural contraction of a muscle is of any service to the body. Anything beyond that or less than that is useless or harmful. The vocal chords, in contracting, pull upon the cricoid upward and the thyroid downward, but since the cricoid cartilage is a part of the trachea, grown with the other rings into one solid tube, this cartilage cannot be drawn upward, hence only the downward pulling force of the ligament is available. This force is sufficient, however, to prevent the muscles which pull upon the thyroid cartilage upward (as will be later described) from dislocating the thyroid. As this muscle connects only the frontal parts of the cartilage, and since the thyroid cartilage simply rests upon the back of the cricoid, other muscles are needed to prevent the rear part from leaving its position. These muscles are found to the left and the right sides of the ligament (Figs. 2, 3, 4). They are the crico-thyroid muscles. Now, when all these muscles contract, the thyroid cartilage tilts downward in front and closes the hollow

space or niche between it and the cricoid. Also since the vocal chords are being held in the rear by the arytaenoides and their muscles, they are being drawn somewhat down in front, thus stretching them to some extent.

At the expense of seeming tedius, it must be stated that all these important actions could not take place if the cricoid cartilage were not firmly fixed as a part of the air tube. For if the cricoid were movable, then the muscles which connect it with the thyroid could contract but very little. At least one of the two parts to which muscles are attached, must be firm to give the necessary resistance against which they can contract. Take a friend's hand and pull it toward you. If he does not resist, then you can not exert yourself, but the more he resists, the stronger you can pull. Now it is true that the entire air tube can be raised somewhat, and that is what is done when the larynx is raised for high tones, as is often wrongly advised. But in so doing it is made impossible for the muscles just described to contract sufficiently to stretch the vocal chords, because if the air tube is raised it loses its natural hold in the chest and, as a consequence, all the other forces are weakened. Similarly, if you lower the larynx for low tones, you also lower the air tube and alter its natural position, weakening its action and all other parts with it. If you pull a finger out of joint, it cannot move up or down because it is dislocated. It is so throughout the human body; each member can do its work only from its naturally appointed position.

Muscles Connecting the Cartilages of the Larynx

You are now requested to examine the position of the hyoid bone in illustration IX, Fig. 9. Picture to

yourself that the long horns reach far back on both sides of the throat and directly underneath the tongue, with which the hyoid bone is very closely connected. Just as the cricoid and thyroid cartilages are connected, so the hyoid and thyroid bones are connected, first in front by a ligament (Fig. 5), and then on both sides by muscles (Fig. 6). Now some close reasoning will be required of the reader to understand and digest the seemingly involved (but in reality, very simple) actions of all these muscles. The three cartilages, cricoid, thyroid, and hyoid, must be closely brought together to make a hollow tube. It was said that the cricoid, being a part of the air tube, affords a firm basis for the contraction of the muscles to the thyroid, but if this cartilage were not itself provided with muscles to hold it, then the thyroid could not resist the cricoid muscles. The two cartilages would merely lie one upon the other in a loose, flabby state, utterly useless for vocal purposes. Consequently, the thyro-hyoid muscles must be able to resist the muscles below them, but the hyoid bone, as illustrated, affords no hold to the muscles below it or to the thyroid. How, then, could all the described muscles contract, how could these three cartilages be brought into a firm hollow tube? We must find some means whereby directly or indirectly a firm hold is provided for the hyoid bone. Otherwise the chain of resistance would be broken and musical tones would be impossible. To find this support for the hyoid bone, leads us to the external voluntary muscles and to the solution of the question of how voice can be developed.

CHAPTER IX

External Voluntary Muscles—The Tongue

THE muscles and their actions so far described are mainly involuntary, that is, their action takes place automatically, without one's being conscious thereof. The muscles which will now be described are voluntary, which means that they can be brought directly under the conscious control of the will, and can be strengthened and developed to the utmost perfection. That this is possible makes voice study just as exact as piano playing. One has only to learn what should be done, and then persistently do it until perfection is reached. With these facts proven, voice study is no longer a matter of guess work, hypothesis or mere speculation, but a practical science open to all. The next illustration (X) presents a view of the larynx and tongue with most of the muscles connecting them.

In our search for a support for the hyoid bone we arrive at the second most important part of the vocal organ—the tongue. The tongue (Fig. 5) is practically all muscle. When the mouth is closed the tongue fills the entire space within, reaching backward into the food pipe. When the mouth is opened the tongue may be protruded, many movements made and changes of form and position be assumed by this versatile member. These changes occur during eating, chewing, and swallowing, but more especially during speaking and singing. The tongue is not only a most important part of the digestive apparatus and the organ for tasting, approving or rejecting food, but it is also a very important part of the vocal organ. We must remember that what we

see of the tongue when the mouth is open, that is, the point and the surface, is the smallest part of it. The tongue grows out of the lower jaw (Fig. 8), to which it is firmly attached by a tendon, called the septum lingua. This tendon connects with the hyoid bone. Most of the other muscles which constitute the tongue grow out of the bony parts of the skull, which affords them and through them the entire tongue, a very firm hold. In our search for a hold to the hyoid bone, we will learn much from an examination of illustration X. Growing out of the horns of the hyoid bone (Fig. 9), we see two broad bands of muscles going straight up into the tongue. These muscles are the hyo-glossi (Fig. 2), and back of them lie the chondro-glossi muscles (Fig. 3). These latter are of the greatest importance. When they contract, they pull or attempt to pull—which is the same—the hyoid bone upward. This contraction serves to give the muscle (Fig. 1) from the thyroid to the hyoid bone the necessary resistance. Then the crico-thyroid, still lower down, can also contract. But, again, what support is provided for the tongue? If the tongue were not supported then the hyoid and chondro-glossi muscles could not contract, and we would be no better off than before. All the muscles above the hyoid bone and the lower jaw are parts of the tongue, so when I speak of a tongue support I mean these muscles. Growing out of the firm, strong base of the skull, the stylo-glossi muscles (Fig. 4), (there are always a pair, one right and one left) reach nearly to the point of the tongue forward, constituting the outward rims of the tongue. As this muscle curves strongly upward, it would, in contracting, pull upon the hyo-glossus and chondro-glossus muscles, thus giving them a firm hold. But since the stylo-

glossus muscles not only branch upward, but also backward, they would pull the entire tongue also backward, and thus destroy any support to the muscles below them. To offset this, there is an exceedingly strong muscle growing out of the chin in a fan shape backward into the tongue, the genio-glossus (Fig. 6). This muscle in contracting would pull the tongue strongly forward, thus preventing the backward drawing of the stylo-glossus. Now, when all these tongue muscles contract with equal force, they support each other so that there is no other perceptible change beyond a general thickness and firmness of the tongue. They each retain their natural position except for a slight shortening. Aiding the stylo-glossus there is another pair of muscles, the palato-glossus (Frontispiece, Fig. 14), growing out of the soft palate in an arching line down to the rear sides of the tongue. This muscle grows out of the soft palate, hence there must be found a support to the soft palate; this support will be described in the next chapter.

We have now one continuous chain of muscles from the air tube to the skull, each supporting the one below. By these the external parts of the vocal chords may be stretched sufficiently for a thin tone, but the muscles which lie behind the external chords, inside the larynx, would not be affected, because the stretching force so far described is not enough to call the entire vocal material into action. Close reasoning on the student's part will show him that all these muscles in reality pull the larynx and with it the air tube, upward. Now the air tube is fastened by its lowest branches into the soft lungs, which cannot resist a very strong upward pull. Then, too, the entire tube hangs freely, loosely in the throat, too loose to permit the utilizing of all the vocal

material. Again, the upward pulling muscles do not tilt the thyroid cartilage downward sufficiently to stretch the vocal chords, because their tendency is merely straight up. We must look first for a much firmer support to the air tube and larynx, and, secondly, for a device to tilt the thyroid cartilage downward.

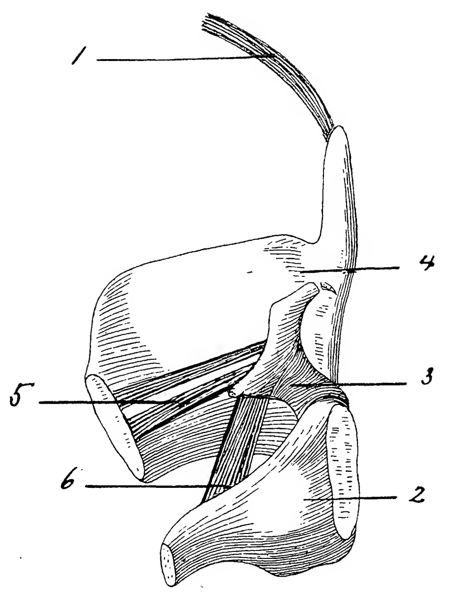

ILLUSTRATION XI

PALATO-PHARYNGEUS MUSCLES (LEFT SIDE REMOVED)

1. Palato-Pharyngeus Muscle.
2. Cricoid Cartilage.
3. Arytaenoides Cartilages.
4. Thyroid Cartilage.
5. Vocal Chords.
6. Crico-ArytaenoidesMuscles

CHAPTER X

External Voluntary Muscles—Continued
The Larnyx (Downward Pulling)

IT HAS not been the purpose of the writer to describe the anatomy of the vocal organs from the viewpoint of the professional anatomist, but from that of the voice teacher, whose aim is to minutely and accurately describe that part of the vocal apparatus which has to do solely with the voice and speech. We must bear in mind that the first purpose of the vocal organ is to supply the lungs with air. Furthermore, that that part of the vocal organ which we call the mouth and the pharynx was designed to receive food and pass it into the aesophagus, or food pipe, immediately behind the larynx and air tube. To supply all these parts with the necessary muscles and tendons, to connect the head with the chest, to provide the possibility for the manifold motions and positions needed, a large number of muscles are provided which do not directly affect the vocal organ. They are not mentioned here, though in a later chapter the influence of the throat and head muscles will be touched upon. It may be stated that the throat and head muscles do not interfere with the voice, therefore they need not concern us in the least, so long as the true vocal muscles operate correctly. It is only when a certain one of these vocal muscles does not operate properly that the non-vocal muscles interfere. The voice student should know what to do rather than what to omit. I teach a positive building process rather than a negative "don't."

Something of the inner working of muscles may be of interest to the student. As a rule, muscles connect the bones of the body through the medium of a ligament or tendon. A muscle consists of an origin, body and head. By the origin is meant a bone that is firmly fixed. Out of this bone the muscle grows, while the other end or head is attached to a movable bone. Muscles are formed into groups; several muscles perform the same office, as for instance, when we take a step, there are several muscles which unite to move the bones at the same instant. Each group of muscles is supplied with one or more nerves.

Dr. Foster of London, England, in his interesting work, describes the inner workings of a muscle thus: "One should think of a muscle as containing many cells which lie beside one another like particles of powder. To each of these particles leads a thread from the central battery of the brain. The explosion of one of these particles contracts the muscle instantly, and it remains contracted until a part of the negative battery is exploded, when the muscle at once returns to its original relaxed position. If we try to force a muscle it refuses to work, because, as it seems, the positive and negative batteries neutralize each other, so that the muscle cannot work at all. After the particles are exploded, the muscle is tired or broken down. During rest the blood builds up new particles, and in this way a muscle is rebuilt and made stronger."

Therefore, all ideas of force must be dismissed. But the theory of looseness and flabbiness, so often taught, is just as pernicious. In both cases the muscles refuse to work and become useless. If, however, we strengthen the muscles, there is no need to force them, for they will then do their work automatically.

The frontispiece is a composite picture of the entire vocal apparatus, and was designed by the author of this work. The breastbone and collarbone (Fig. 6, 7) form the basis for the connecting muscles. To support the food pipe, and especially the air tube and larynx for swallowing and coughing, or for the purpose of a strong voice, a triangle of muscles surround the throat, running from the front and the sides upward.

The sterno-hyoid muscles (there are always a pair) start at the outermost points of the collar bone, and run in an almost straight line up to the hyoid bone (Fig. 5). Contracting, they pull the front of the hyoid bone downward. They are aided by the omo-hyoid, which runs from the rear part of the collar bone in a curve to the hyoid bone. In contracting, these muscles also pull the front of the hyoid downward, and since they are strongly curved backward, they, at the same time, press the lower part of the larynx strongly backward against the spine, thus giving the vocal organ a strong bony support against which it rests. This point acts as a fulcrum, against which the down and up pulling muscles can contract with very great chord-stretching effect. Still another pair of muscles assist these remarkably strong downward-pulling muscles. It is the sterno-thyroid muscle, which lies between the two muscles just mentioned and runs from the collar bone to the thyroid cartilage. It especially tends to draw the front of the thyroid cartilage downward, thus closing the niche or open space between the thyroid and cricoid cartilages (Ill. X, Fig. A) and stretches the vocal chords most completely. Now, picture to yourself vividly that these three pairs of strong muscles pull the front of the entire larynx downward and

backward, and, of course, also pull the front parts of the vocal chords downward, below the level of their rear attachment.

CHAPTER XI

External Voluntary Muscles—Continued
The Larynx (Upward Pulling Muscles) And the Pharynx

THE question will at once suggest itself, "What forces oppose these downward-pulling muscles?" For, if there were no opposition, the larynx and the vocal chords would merely be pulled downward into the throat. Not even the downward-pulling muscles could contract, because they would have no resistance against which they could pull. To pull yourself upward, you first need a bar or some strong object that you can grasp, and secondly, sufficient muscular power to at least raise your own weight. We must find the forces which pull the larynx upward. Part of these forces have been described in the chapter on the Tongue. In the frontispiece (Fig. 10 A-B) we see the two broad muscles, the hyo-glossi and chondro-glossi. These pull the rear horns of the hyoid bone upward, and with them the larynx.

The Palate

The palato-pharyngeus muscles (Fig. 1, Ill. XI) arise out of the soft palate (Fig. 9, Frontispiece), and extend backward and downward into the upper horns of the thyroid cartilage. Their action would pull the rear part of the thyroid cartilage upward, thus opposing the downward-pulling muscles. This assists in the stretching of the vocal chords. Another illustration will make this still more plain.

As seen in this illustration, the palato-pharyngeus muscles (Fig. 1) pull, not only upward, but forward as

well. They are fastened to the upper horns of the thyroid cartilage (Fig. 4), which pivots on the back of the cricoid (Fig. 2) below it. The action of the vocal chords (Fig. 5) within the thyroid cartilage is also very plain, showing that the pulling of the horns tilts the cartilage downward and thus assists in the chord-stretching process. But this muscle grows out of the easily-yielding soft palate. How, then, can it contract and pull the larynx upward?

The palate is the roof of the mouth and at the same time the floor of the nose. It consists of the hard bony part in front (Fig. 15, Frontispiece), and the soft, flexible part behind, which extends down into the pharynx, ending there with its appendix, the uvula (Fig. 9, Frontispiece.) Its sides form the two arches over the rear of the tongue, which can be easily seen by opening the mouth. The front of the arch constitutes the palato-glossi muscles, already mentioned in the chapter referring to the tongue. The rear arch is formed by the upper portion of the important palato-pharyngeus muscles. But still another difficulty presents itself, for the soft palate cannot support the palato-pharyngeus unless it is itself supported by some other attachments. These attachments are provided by muscles which grow out of the soft palate into the skull (Fig. 16, Frontispiece). They pull the soft palate backward and upward. Their backward movement partially closes the opening to the nose, thereby preventing nasal tones. The upward pull opposes the downward pull of the pharyngeus muscles. Then there are the tensor-palati muscles, running from side to side of the soft palate into the tooth-like little bony projection behind the upper molar teeth. These serve to make the entire palate more tense, so that a

still better resistance is provided; furthermore, greater resonance is thereby made possible.

The above description shows that the palate should never be raised during voice, as is sometimes erroneously taught, for, were it raised, there could be no resistance and the power of all the muscles would be lost. Likewise, there should be no lowering of the palate during voice. The front of the soft palate, where it is attached to the hard palate, becomes tense and swells a little downward. The uvula being only the soft appendix, is somewhat shortened, so that during voice it stands a little higher than before, but the main part of the soft palate remains in its natural position, only becoming more tense.

The Pharynx

The cavity of the mouth leads directly into the cavities of the pharynx, of which there are three; one is immediately behind the palate muscles leading downward into the food pipe, another is that cavity from the rear part of the tongue to the nose; the third being the cavities of the ears. All these cavities are formed by the bony structures surrounding them and they are lined by various muscles. The open form of these cavities, according to the much quoted anatomist, Luschka, is subjected to constant changes during speech, in singing, and especially in the act of swallowing. The arches of the palate approach each other until they almost touch. This shortens the pharynx from the lower to the upper parts, so that the wall which was visible and free before, becomes hidden as by two closed curtains. With the assistance of the roots of the tongue (hyo-glossi and chondro-glossi muscles), the larynx can be strongly pulled

upward. This action is especially marked in high tones. The soft palate, a true diaphragm-pharyngeus, is only complete in man, while, for instance, in the dog, the uvula and the tongue-to-palate muscles are lacking. The purpose of the palate in the animal is merely to close the cavity to the nose, while in man it serves in addition to the closing of the nose cavities, also the purpose of raising the larynx.

PART THREE

CHAPTER XII

The Law of Mechanics—
Why Voice Students Sometimes Fail

MOST students fail because they lack an exact scientific method of instruction. It is known that, by lowering the larynx, the voice can be made stronger, and that through the raising of the larynx, higher tones can be reached. In neither case, however, are the tones really good. The lower tones become rough and throaty, the higher tones shrill or thin. The habit of singing directly from the vocal chords (glottis attack) is also bad, because in this case the vocal chords rub against each other and become inflamed. Good breathing is of great value, but the breath can only set the vocal chords into vibration; nothing more. In a correct vocal attack the breath is instantly converted into tone. The much advised humming of the tone or focusing to the front or face, is of no permanent value. It merely deceives the singer for a time. No vocal device, of whatever kind, can possibly assist the student in his search for a perfect voice.

Nature provided the only means whereby the needed stretching of the entire vocal material can be automatically accomplished without causing the singer any exertion. The condition to such a happy result is that the vocal organ must be made equally strong in all its parts.

When we consider the triumphs of modern mechanics, such, for instance, as the building of the Panama Canal, the St. Gothard Tunnel, or the luxurious ocean steamers, the first question which suggests itself is how were they created? Naturally, first in the brain of the engineer; secondly, they were reasoned out, designed and sketched on paper, and not until then could the practical work be started. If the engineer's measurements and judgment were correct, then this theory must prove correct in practice. Just so in the vocal apparatus. When all that is necessary to make a perfect voice, is understood, then clear thinking and sound reasoning will be sufficient to show the way toward perfection, and practice will demonstrate that this reasoning was correct.

The author has now given all the details of the mechanism which operates in singing. If all these details work together in unison, the voice will be the best that is possible to the individual. If not, then we must find out wherein one or more of the details failed to operate, and correct it. No other way has any chance of success.

Only the muscles from the tongue to the hyoid bone (Fig. 10, A-B Frontispiece) need concern us in the search of equal forces, for these reasons: First, these two pairs of muscles are located in the center of the vocal organ. They are attached both to the palate above and to the larynx below. Therefore, they naturally pull both ends toward each other. Secondly, these tongue-to-hyoid-bone muscles are the only ones in the entire vocal organ which are entirely free; that is, are nowhere attached to fixed bones like the other muscles. Also they have a separate nerve supply. Thirdly, because these muscles are free, they can be brought under the voluntary control

of the singer. If he uses these muscles, the tone will be large and beautiful. If he omits them, the tone will be thin and lack the necessary quality.

A New Discovery

Although the above facts have been known to anatomists and open to singers as well, for some time, yet both have failed to grasp their importance as related to the voice. The anatomist naturally thought of them only in relation to the medical service or operating table; the singer and musician concerned himself very little, if at all, about the vocal anatomy. Firstly, because the musical temperament is usually opposed to a scientific analysis, dealing preferably with emotion. Secondly, he had been taught that to think of the vocal instrument was to become self-conscious. He was told to think in tones, and that then the instrument would take care of the rest. The real reason why the control and development of all these important muscles did not suggest itself to the singer was because tongue muscles cannot be felt.

It may seem strange that this group of muscles, whose importance cannot be overrated, should not also be strongly felt. But because these muscles are nowhere attached to a firm bone, they leave no sense of exertion or contraction behind them, especially when, as is the case in singers with exceptionally fine voices, these muscles are almost abnormally strong. This is also the reason why good singers and speakers feel no exertion, why the action of the vocal organ seems to become freer the longer they sing or speak. This freedom and strength of the tongue muscles accounts also for the free tone and the easy execution of the most difficult

passages, as well as the many shadings and special effects employed by the great singers.

Now, examining the frontispiece again, we may logically deduct certain mechanical facts; Suppose that the three pairs of muscles which grow out of the breastbone (Fig. 6) and the collar bone (Fig. 7) into the hyoid bone (Fig. 5), and to the thyroid cartilage (Fig. 2 A-B), and overlapping the cricoid cartilage (Fig. 4), have altogether a contractile power of, say, 25 pounds. Then, to offset their downward pulling force, we must have the equal of 25 pounds of upward pulling force. Now the palato-pharyngeus muscle, which pulls the thyroid cartilage upward, is considerably thinner than either of the three downward-pulling muscles. Also it is too long and too far from the object it is to move, and for these reasons it cannot be as strong as either of the opposing muscles. Now we have the two up-pulling tongue muscles (Fig. 10, A-B), to supply the missing power. It follows that these tongue muscles must be of exceptional strength. Two facts, however, operate against these muscles; one is that they are nowhere attached to a firm bone; the other that singers are not even aware of the existence or importance of these muscles; hence the singer cannot help himself.

The Remedy

When these tongue muscles are strong enough to supply the necessary up-pulling power, they set the entire vocal organ in motion. The vocal chords are then automatically stretched and singing becomes a pleasure. This is the case with the great singers who, through natural inheritance or for other reasons, possess exceptionally strong tongue muscles. But those whose voices

are not all that they desire, may now develop these muscles until they are just as strong as those of the great singers and thereby acquire a perfect voice. Since these muscles are comparatively easy to get at, they can be trained and developed. Practical tests on hundreds of students have proven in every case that this theory is not only correct, but absolutely infallible. This places voice study on an exact scientific basis and solves a problem which has troubled voice teachers for over three hundred years.

CHAPTER XIII

The Contrary Proof

SO FAR it has been the author's aim to furnish positive proof that the vocal organ must be perfected before one can have a perfect voice. It has also been shown that it is the tongue muscles which cause all the trouble, and that when these are strengthened and developed a perfect voice becomes an assured fact. A still further proof will now be given. If the vocal organ is deficient, the voice cannot be the best or nearly the best that is possible to the individual. He may sing, but a close observer will notice one or more of the following defects in his voice: The tones may be good up to a certain range, usually about F on the fifth line for high voices, about C or D below that for low voices. After that the tones become either soft and thin or else loud, piercing and hard, or the compass will extend no further than the tones above mentioned. Such a compass is entirely too limited for a successful career.

Soft tones should be employed for special effects only; they are unsuited for normal, public singing. Loud, piercing, or hard tones are, of course, always offensive.

How Does the Singer Realize His Faults?

Naturally, a singer realizes first in a musical sense, that some of his tones are not so good as others, or that some tones require much greater effort than others. He may, indeed, get relief by employing special means, such as greater breath pressure, or focusing the voice toward the head, or by the singing of other vowels than the

normal "aa"; but at best these means help only temporarily. In the end he is worse off than before, because he has added new faults to those he previously possessed. But there are physical signs which tell him unmistakably whether his tones are correct or not. For instance, if, on high tones, the tongue is drawn far back from the teeth and rises in the back, and more especially if the tongue becomes hard, it is an infallible sign that his vocal organ is imperfect. Again, if the tip of the tongue braces itself against the front teeth, his organ, while reasonably correct, is still far from being perfect. If his tongue sinks down into the throat, if it is flabby, or very loose, it is a sign that the all-important muscles are very weak. If the jaw becomes stiff or the palate rises or spreads apart in the back of the mouth, the organ is imperfect.

But if his tongue rises a very little all along in a straight line from tip to back, or if the tongue becomes somewhat thick, and most especially, if he sings with utmost ease throughout the scale on every vowel, his vocal organ is sure to be right. Such a favorable condition is rarely to be met with; not very many singers nearly approach this ideal condition, but if they knew where the weakness was to be found, they could correct it, and then their tones would soon become freer and better. Often a few months' practice will develop a voice to undreamed of beauty, power and compass.

Muscles Which Interfere with or Entirely Prevent the Correct Chord-Stretching Effort

It can be stated with absolute truth that voices would be much better, and there would be more good voices, if the singer, at the beginning of his career, would, physiologically speaking, employ only those muscles which

are essential to a good voice. If one begins right and continues to use the correct vocal mechanism, it will gain in strength every day and his voice will become more beautiful and the compass will increase. This is the case with the great singers, who preserve their voices to old age. On the other hand, if the correct mechanism is not under the singer's control, there is a constant temptation to employ other muscles to temporarily force the voice, and these, in the end, also destroy it.

Suppose the voice is naturally pretty, but too light and soft for public use. The singer's natural instinct would be to make the voice larger by a greater exertion; now, the legitimate, correct vocal muscles cannot, as has been explained, be forced. Therefore, if he exerts himself, he is not using the correct vocal muscles at all, but others which lead him astray, because, temporarily, they help to give his tones greater power.

There are several muscles to the hyoid bone, other than those already described, which can obstruct the chord-stretching.

First, by preventing the upward-downward tilting of the hyoid bone, which would also prevent the thyroid cartilage from being tilted downward in front.

Second, by drawing the hyoid bone and the larynx forward, which again would interfere with the natural chord-stretching.

The first fault is caused by the digastric muscle (the muscle employed when chewing). It runs from the cranium to the hyoid bone and the chin. It prevents the tilting of the hyoid bone and the thyroid cartilage, because it pulls them straight upward and backward. Two other muscles also oppose the correct vocal chord-stretching in a similar, but less degree; they are the stylo-

hyoid muscle, from the skull to the hyoid bone, and the mylo-hyoid muscle, from the lower jaw to the hyoid bone.

The second fault is caused by the powerful genio-hyoid muscle (Fig. 7, Ill. X). It is attached to the lower part of the chin and runs to the front part of the hyoid bone. It, therefore, can draw the hyoid bone, and with it the entire larynx, forward, but with most injurious effect to the voice.

All these muscles belong to the lower jaw. They are very strong, because they were designed to open and close the mouth. These muscles are still further aided by the muscles which pull the jaw upward. All these muscles combined possess very great power and by their contraction they interfere greatly with the true vocal muscles; that is, with the entire muscular apparatus which moves the larynx and stretches the vocal chords.

The temptation to use these chewing muscles is very great. We associate in all physical efforts a corresponding muscular exertion. If a heavy weight is to be lifted, we instinctively determine upon a corresponding effort which we expect to feel in our arms and shoulders. So, also, the singer judges that a louder tone demands a greater effort, and naturally enough, thinks that he must feel a greater effort. And just here is the great danger of using the jaw muscles. They are strong and ever ready to help; besides, they at once change the tone and deceive the singer into believing that he is right.

Since these muscles have such a great power to excite sensation, many suppose that the jaw muscles must be kept absolutely relaxed and loose. This is natural enough, but in relaxing the jaw muscles he also relaxes the entire throat, and, in so doing, he relaxes the essential chord-stretching muscles also, since he cannot differ-

entiate between them. Now when the essential chord-stretching muscles are relaxed, the vocal chords must also relax; that is, they surrender their enlarging, condensing effort; thereby making an artistic voice impossible. Only feeble or breathy tones are possible when the vocal muscles are relaxed.

Either of these two conditions is the almost universal rule among singers. The exception is hailed and worshiped as a star. If voice study were rightly understood, stars would be the rule, and failures the exception.

In correct singing, that is, when the tongue muscles are trained and made strong, there is a very powerful contraction of the true vocal muscles. But these contractions are not felt as an effort or an exertion. In fact, there is no strain anywhere.

Every one of the tongue muscles described in the previous chapters has a functional share in the whole combination, while every one of the jaw muscles interferes with the true artistic voice. Mechanical calculations alone show that only the hyo-glossi and chondro-glossi muscles, which extend upward and forward from the hyoid bone into the tongue, are legitimate agents, for only these can assist the sterno-hyoid muscles (from hyoid bone to breastbone) in tilting the hyoid bone and the thyroid cartilage downward upon the cricoid joint to stretch the vocal chords. These muscles pull the rear horns of the hyoid bone upward; at the same time the sterno-hyoid pulls the front of the hyoid bone downward. Of course, this action also tilts the larynx downward, being assisted by the sterno-thyroid muscles (from thyroid cartilage to breastbone), provided the cricoid bone is held firmly against the spine, which is always the case in the correct action as here given.

This fortunate division of the right and wrong muscles into two classes, tongue muscles and jaw muscles, makes vocal study an infallible, exact science, which can be demonstrated with mathematical certainty.

One more fact remains to be mentioned; that is, when all the true vocal muscles act powerfully together, a feeling of openness or looseness is experienced by the singer, leading him to believe that all muscles are relaxed. This feeling is correct, but the inference that the muscles are relaxed, is a mistake. A relaxed muscle, means a dead muscle, without life and energy. Such a muscle cannot do any work. But a stiff or tense muscle is also useless, for it is held too tight to perform any other office than that of stiffening itself. Neither a relaxed muscle nor a tense one is of any use. What is needed is a flexible, strong muscle, that can contract with great rapidity and, because of its strength, also with great ease.

One needs only to look at a superior athlete or acrobat for an illustration of flexibility combined with muscular strength. Again, if a pianist were to relax his fingers, there would be no strength, consequently only a feeble weak tone; but if his fingers are stiff, there can be no rapidity of movement. If, however, his muscles are flexible, and through practice are made strong, there will be no apparent effort, even for the biggest tone, and his movements will still be rapid. So, also, if the correct vocal muscles are made strong, there will be no stiffness, and certainly no relaxation.

There is only one way to develop a muscle's strength, and that is the muscle's own effort against resistance. Many years of study and experiment tested upon himself and hundreds of students, among whom are many who

are now in the front ranks of their profession, in the leading operas of both Europe and America, as concert singers, dramatists and voice teachers, have proven that the method devised by the author is not only correct, but that it is the only possible way by which the student can develop his voice and bring it to perfection.

CHAPTER XIV

Breathing

IT MAY be assumed that in most cases, to those singers or speakers who, by nature or by the study and practice of the method devised by the author, sing only with the action of the true vocal muscles, the correct method of breathing will gradually and instinctively assert itself. Even if such should not be the case, the tones will still be beautiful and large; but for the purpose of smooth phrasing and easy diction, and still more for the purpose of tone shading and expression and other special effects, correct breathing is essential.

Many attempts have been made to establish different systems of breathing, but they are all more or less based upon opinions and experiences of singers and teachers who believed that their system was the best possible. Much good has been accomplished by these means, but such systems could not cover all points and cases, because in the first place the systems were not written out in the exact scientific manner which alone can explain and direct the correct way of inhaling and exhaling breath. Furthermore, it requires not only a general knowledge of physiology to establish the use of the true breathing muscles, but also a most painstaking minute search and long experience, which is generally acquired only by the specialist.

The confusion which stlll exists in regard to breathing is best illustrated by referring to differences of opinion in regard to abdominal, chest or diaphragmatic breathing. When, as a matter of physiological fact, neither one alone is correct or even possible. We do not, for instance, inhale at all, nor is the breath ever expelled. To inhale

the breath would take up too much time. It could not take place as instantaneously as is required for the minute pauses between phrases in singing and speaking. What we really do is to create a vacuum which is at once filled by the air. This vacuum is created by a set of muscles specially adapted for this purpose. Then to convert this air or breath into tone, an entirely different set of muscles is put into action. These two separate functions govern the chest, diaphragm and abdomen so that each has a certain share in the work accomplished. Neither of these predominate in correct breathing. The subject, however, is too complicated to be treated in a work which has as its sole object the technical explanation of the vocal organ. Although the breathing organs are a most necessary and indispensable part of the entire vocal apparatus, yet that apparatus is by Nature divided into the vocal organ from breast and collar bone upward, the breathing organ from these bones downward. So it was deemed best not to overburden the student with too much material which might, in the end, confuse him. He is advised to completely master the subject, "The Vocal Organ," as here given. A special work on breathing has been prepared that covers the subject completely. In it will be found a minutely exact description, with necessary illustrations, of the entire breathing apparatus, the relation of the separate parts to each other, and the function for which each set of muscles is created, with detailed instructions for using them so as to gain the best results.

Conclusion

The chief end and aim of art should be to give joy, to arouse noble sentiments, by speaking to the heart

first. In music this is done by beautiful sounds, therefore the singer's object should be to develop his voice so that all the beauty and nobility which is in such superabundance about us, can be set free. Only after such beauty of tone is at the command of the singer, will the study of songs become of any value. Then intelligence will be added to emotion, and the two united into one perfect work of art. Voice is the result of physical conditions, much the same as in any other musical instrument. It is subject to similar laws, and in the case of tone quality, to identically the same laws.

It has been shown that the tone quality is dependent upon the perception by the ear of the overtones arising out of the fundamental tone. But the overtones cannot be strong enough or numerous enough unless the primary or fundamental tone is strong, hence the fuller the tone, the more numerous are the overtones, and the finer and sweeter is the quality of the tone to the ear. Now in order to gain a larger volume of tone, we must utilize all the vocal material which we possess. That means, that all the muscles which constitute the vocal chords must unite and condense into practically a single chain of muscles. In addition to this we must be able to stretch this united muscle. This can be done only by the external laryngial muscles, and of these again only the tongue muscles need to be trained and developed. This reduces voice study down to one single exercise. This simple exercise gradually changes the weak muscles into strong muscles, and as soon as the full strength is acquired, the full beauty and power of the voice is possible, and to the author's positive knowledge this voice will be a revelation of glorious beauty.

The Perfect Voice Building Method

The author has shown the cause of weak and imperfect voices and has demonstrated that the muscles at fault have been located and can be isolated and placed under the voluntary control of the person. We now wish to inform you that he has prepared a course of instructions, which tell exactly how to develop the vocal organ, so as to create for the voice a great increase of strength, volume, flexibility, tone and beauty.

These instructions explain in detail Professor Feuchtinger's complete method of voice building—the method which has brought him such a large measure of success in his work. We might write a volume about this simple but wonderful method, but we believe that nothing we might say would give you such a clear appreciation of its worth, as to read what his European students say of it. They speak from personal experience.

As you read you will notice that this method has been equally successful with all kinds of voices, and under all kinds of conditions. We state only the truth when we say that the method never fails. After having read the following extracts, if you are interested in improving your voice, write to us for a copy of "The Perfect Voice." It will be sent to you free. Address

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The Following Are a Few Extracts from Letters Received from Students

Madam Ellen Forena, Metropolitan Opera, New York, formerly with Kubelik:

"Your method has in a short time *restored my voice.* You have gone to the root of the matter. I shall always practice your intelligent method, that I may not again *lose my voice,* as happened through incompetent instruction."

Rev. F. H. Brinkmann, Fruens Boege, Denmark:

"My voice has become stronger, speaking is easier, even my throat is much better. I do not get tired after prolonged speaking, nor do I get hoarse, as I formerly did."

Ludwig Henry, Professional Reader, Berlin, Germany:

"I have never studied singing, but took up your exercises, with the astonishing result that now I have a beautiful, healthy singing voice, of which I had no knowledge heretofore."

Miss Ylva Hellberg, Yaerfa, Sweden, Dramatic Soprano, Royal Opera, Aachen, Germany:

"Without your method I would never have advanced so far and so quickly. All my friends say that what no one had before been able to do, Professor Feuchtinger has accomplished. Before I studied with you my voice was useless."

Mr. Hans Wohlrath, Ph. D., Berlin, Germany:

"I bless the day I found you. Without your method I would still be floundering in the mists of darkness and uncertainty. If the philosopher Kant gave the Germans the title of "The Nation of Thinkers," you should be called the creator of a "Nation of Nightingales." I sing now with enthusiasm and joy, my best parts being the slow flowing cantilene passages."

Mr. G. Alm, Chailly sur Lausanne, Switzerland:

"I want to tell you that my wife has made enormous progress. Her voice is large and very beautiful, it reminds me more and more of the voice of Calvé. The voice is always the same—always dependable."

Rev. A. Haibt, Rector, Bishops Seminary, Rottenburg, Germany:

"I am very glad to tell you that, by continuing the exercises which you taught me, my voice has made great progress. I have spoken much of your method and recommended it in the 'Magazine for Pedagogie.' "

Mr. Sverre Dahl, Concert Singer, Christiania, Norway:

"My concert here was an immense success. All criticisms were favorable, some even splendid. They all say that my voice is remarkably fine, that my diction is perfect and that I must have had an excellent teacher. I was re-engaged for a popular concert here and for several other cities."

Mrs. Meta Lautier, Opera Singer, Hamburg, Germany:

"Perhaps you remember that in the spring I sang to you the 'Brunhilde' from the 'Walkuere' and at that time I could not sing a tone in the higher middle range. I am now more than pleased to be able to tell you, that not only that range, but also the highest note in the part, is now easy for me."

Mrs. Lola Wieland, Concert Singer, Montreal, Canada:

"Since taking your instructions my voice has constantly improved' The middle range and the 'mezzo di Voce' are especially good, as is also my diction. The tone is no longer throaty, but placed where it ought to be."

Joseph Schaefer, Dresden, Germany:

"Professor Feuchtinger's lecture in Dresden aroused my enthusiasm. As I am a student of the Royal Academy of Art in Dresden, I am well schooled in anatomy. I have studied the vocal instrument, both in the dead body and with the help of the best works on physiology, and have come to the conclusion that Professor Feuchtinger's method is the only method by which one can acquire a free, large voice. After a few lessons my tone is already free and twice as large as formerly, also my compass has increased an entire fifth."

Mr. H. Stern, San Remo, Italy:

"Since I began practicing your exercises I realize that my voice is improving, and especially that it comes easier and is flexible. Friends for whom I sang were astonished at my progress."

Mr. Johann Jancke, Professor State College, Litau, Bohemia:

"This method guarantees the development of a large compass and a strong voice, because it rests upon the solid foundation of science and truth. It differs from all the old methods in that it trains the muscles which control the vocal chords. In one week's study my own voice increased most perceptibly in strength and clearness."

Mrs. Anna Buenslow, Stockholm, Sweden:

"It gives me great joy to tell you that my voice is very much more free, resonant and strong. Also that after hours of practicing, I do not get tired, as was formerly the case, when even after little singing my voice became husky and tired."

Mr. Willy Ulmer, City Theater, Frankfurt A/M, Germany:

"Your valuable method is most convincing to me because I found in it the explanation of my difficulties and their cause. For ten years I have studied various methods and in various schools without success, but now I have proof that your method succeeds where all the others have failed."

Dr. Henry Moeller, Paris, France:

"Your method aroused my interest, because the principle rests upon a correct scientific, physiological basis. I have tested it myself and find it a most successful voice method."

Mr. Arthur Henroz, Brussels, Belgium:

"For years I have studied with a good Italian teacher, but since studying your method I have obtained results which convince me of its superiority."

Johanna Mierch, Dresden, Germany:

"With grateful heart I can write you that my voice has developed wonderfully fast. I sing the high 'C' and sometimes the 'D' above with utmost ease. I am sure I will soon be a Coloratura soprano."

F. Riis Magnussen, Opera Singer, Dresden, Germany:

"You will be surprised to see how thoroughly I have mastered your method and how at last (after many years' study with other teachers) I have found the infallible way."

Mrs. Margaret Krabb, Hamburg, Germany:

"I thank you for the good your method has done me. My progress is most satisfactory, singing is so much easier. My husband says that it is a pleasure to hear me. The tones are free of all mechanism. I shall always be a disciple of your greatness and the truth of your training."

Miss Clara Gersteroph, Grossherzoglich Baden Opera Singer, Hamburg, Germany:

"As a result of my study with you my voice is again soft and flexible. I recommend all professional singers and earnest students to learn your method."

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doubling the number of vibrations. One-half of this string vibrates with twice the rapidity of the whole string. In the same way one-third of the string vibrates with three times the rapidity, producing a note one-fifth above the octave; while one-fourth of the string vibrates with four times the rapidity, producing the double octave of the whole string. In general terms, the number of vibrations is inversely proportional to the length of the string; the smaller the divisions of the string, the higher the tone. Again, the more tightly a string is stretched, the more rapid are its vibrations. By plucking the string with one hand, while the other hand alternately lifts and presses upon the weight, the quick variations of tension will produce a varying, wailing tone. By applying different weights to the end of the string and determining in each note the number of vibrations executed in a second, we find the numbers thus obtained to be proportional to the square root of the stretching string. A string, for example, stretched by a weight of one pound, executes a certain number of vibrations a second. If we wish to double the number of vibrations, we must stretch the string by a weight of four pounds; if we wish to treble the vibrations we must apply the weight of nine pounds, and so on. The vibrations of a string also depend upon its thickness. If, therefore, of two strings of the same material, equally long and equally stretched, the one has twice the diameter of the other, the thinner string will execute double the number of vibrations of the other in the same time. If one string be three times as thick as the other, it will execute one third the number of vibrations, and so on.

Finally, the vibrations of a string depend upon the density of the matter of which it is composed. If the

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RETAIN SEWING DO NOT TRIM
SEW THRU FOLD BIND AS IS
ADHESIVE BIND MOUNT COVER

SPINE LETTERING/PLEASE TYPE OR PRINT

Feuchtinger

The Vocal Organ, Its Mechanism

SET OF

DATE SENT 10/17/00

COVER COLOR 55

MATCH LETTERING (EXTRA CHARGE)

PRINT COLOR

GOLD
BLACK
WHITE

RUB SENT

SAMPLE SENT

PANEL LINES

BINDERY USE ONLY

OR	NF	HF	CF	PF	
AR	AF	RR	RF	TF	TR

TOP	0	1	4
BOTTOM	0	1	4
FRONT	0	1	4

BE	BS	EC	PA	
F	HA	HL	HP	
MB	MF	MS	KP	
ML	MI	OC	FP	
P	PT	SC	AT	
PC	PK	PL	PM	PO
PP	PV	P3	P5	RL
SR	SE	SW		

PERTY OF ACME BOOKBINDING